FEDERAL AID IN FISH RESTORATION

Job Performance Report, Project F-73-R-6
Subproject IV: River and Stream Investigations
Study I: River and Stream Research Supervision and Planning

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JOB PERFORMANCE REPORT

State of:	Idaho	Name:	River and Stream Investigations
Project No.:	F-73-R-6	Title:	Determination of Stream Resource Maintenance Flows
Study No.:	I		
Job No.:	1		

Period Covered: 1 March 1983 to 29 February 1984

ABSTRACT

Flow measurements were made on Indian and Lion creeks in the Priest Lake drainage for use in determining stream resource maintenance flows using the IFG4-IFG3 methodology. A flow of 0.74 m^3/s (26 cfs) was determined as that being necessary in Indian Creek for protection of fishery values. Insufficient flow data was available to determine a stream resource maintenance flow for Lion Creek.

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OBJECTIVE

To assist regional personnel in field techniques for collecting data used in developing stream resource maintenance flows and to utilize that data in existing instream flow predictive models.

INTRODUCTION

Assistance was given to Idaho Department of Fish and Game Region 1 and Idaho Department of Parks and Recreation personnel in collection of flow data from Indian and Lion creeks in the Priest Lake drainage for the development of instream flow values necessary to protect the fishery values of those streams.

TECHNIQUES USED

A study site was selected on representative cutthroat trout habitat near each stream mouth. Measurements of water depths and velocities were made at 20 stations on each of four cross sections for 3-4 different discharges. This hydraulic flow data was used in the IFG4-IFG3 instream flow incremental methodology for determination of usable habitat over a range of flows, from which stream resource maintenance flows were determined.

FINDINGS

Indian Creek

Water depths and velocities were measured for 0.62 m^3/s (22 cfs) on 8/13/82, 0.82 m^3/s (29 cfs) on 8/11/83, 1.44 m^3/s (51 cfs) on 9/30/82 and 2.63 m^3/s (93 cfs) on 5/5/82. Using juvenile cutthroat trout rearing habitat as the criteria for determining stream resource maintenance flow value, I selected 0.74 m^3/s (26 cfs) as the flow necessary to protect fishery values in Indian Creek (Fig. 1) from the mouth upstream to the confluence of the North and South forks.

Lion Creek

Water depths and velocities were measured for 1.02 m^3/s (36 cfs) on 8/13/82, 1. 36 m^3/s (48 cfs) on 8/11/83 and 2.21 m3/s (78 cfs) on 9/30/82. Information provided by the data collected for these three flows is not adequate to determine a satisfactory habitat-discharge relationship necessary to determine a resource maintenance flow. At least one additional set of measurements at a flow of less than 1.02 m^3/s (36 cfs) is needed.

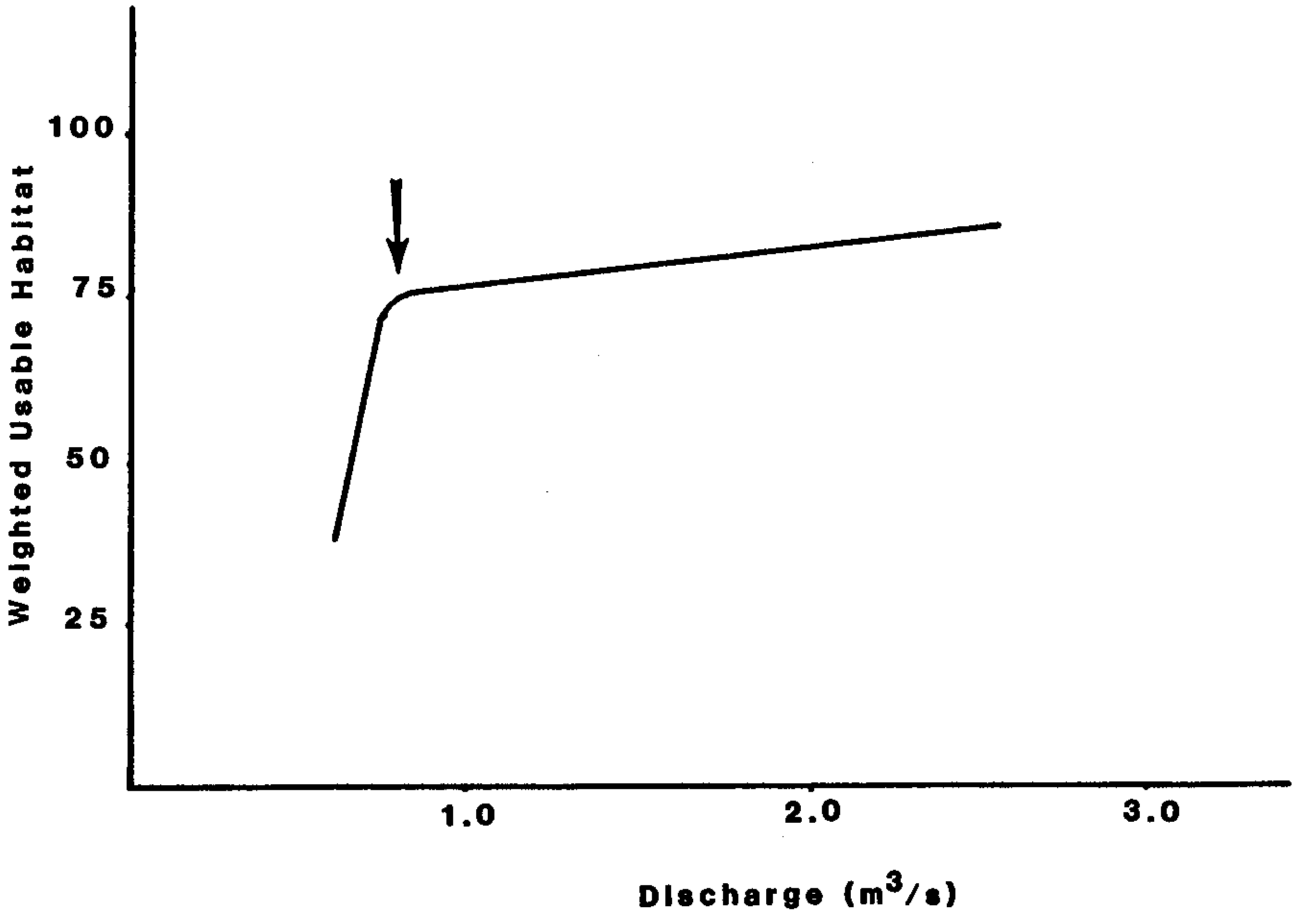

Figure 1. Weighted usable habitat (juvenile cutthroat trout) versus discharge relationship for Indian Creek, Priest Lake drainage, Idaho.

JOB PERFORMANCE REPORT

State of: Idaho

Name: River and Stream Investigations

Project No.: F-73-R-6

Title: Fish Population Simulation Model

Study No.: I

Job No.: 2

Period Covered: 1 March 1983 to 29 February 1984

ABSTRACT

A fish population model was obtained and modified to simulate the white sturgeon population between Bliss and C.J. Strike dams on the Snake River in southern Idaho. The population was simulated to deter-mine changes in composition and abundance under varying harvest regulations. Without better knowledge of natural mortality and fecundity rates, exact changes in the population cannot be determined. However, using a mortality rate that is likely an overestimate, a conservative recommendation of allowing no more than six sturgeon between 125 and 183 cm to be harvested annually is made.

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OBJECTIVE

To develop sturgeon population parameters for use in the population simulation model and predict population abundance under varying harvest regimes.

INTRODUCTION

During the period 1979-81, Department of Fish and Game personnel collected information on the white sturgeon (*Acipenser transmontanus*) populations inhabiting the Snake River between Shoshone Falls and Brownlee Reservoir (Cochnauer 1980, 1981, Lukens 1981, 1982). As a result of those studies, it was determined that only the population of sturgeon between Bliss and C.J. Strike dams was of adequate numbers and composition to be proposed for a change from the existing catch-and-release regulations to a limited harvest regulation.

TECHNIQUES USED

The inland fish population simulation model described by Taylor (1981) was used to predict population sizes under different harvest regimes. The program was modified to simulate 30 age classes rather than the 15 as originally described. The model incorporates age specific population parameters such as mortality, fecundity and growth to predict population status over a 15-year period. The model defines the population size (N) after a period of time in relation to the gain in numbers from recruitment (R) and loss in numbers by natural (D) and fishing (F) mortality. This is represented by:

$$N_{n+l} = N_n - N_n\,(D+F) + R$$

Where: $N_n + 1$ = Numerical population size at end of one time interval

N_n = Numerical population size at beginning of time interval

The model uses age, time and sex specific population parameters. All sturgeon in a given age class were assigned the mean total length and body weight for that age class.

Each simulated year was divided into four time periods, January-February, March-May, June-August and September-December, on the basis of water temperatures. Proportional growth for each time period was also approximated on the basis of water temperatures. No growth in weight or length is expected to occur during January-February, the period of lowest water temperatures. During June-August, when water temperatures are at their maximum, 60% of the growth is expected to occur. Twenty percent of expected growth was assumed to occur in each of the other two periods.

The model allows for a density-dependent growth function, but no supporting evidence was available so it was assumed that growth was not density dependent.

Natural mortality rates were determined on the basis of the slope of survivorship curves (expressed as catch curve). Without knowledge of numbers of sturgeon harvested by age class prior to the closure of consumptive fishing in 1972, exact natural mortality rates cannot be determined from constructed catch curves. For this reason, three different mortality rates were used in the simulation. Mortality rates of 0.27 for ages 4-15 and 0.06 for ages 16-30 were derived from the actual data (Fig. 2). Extending the curve from the age (4) of full recruitment to sampling to the oldest age class (30) usable in the model, a mortality rate of 0.17 was derived. Extending the curve to the oldest age class (45) sampled in the studies, gives a mortality rate of 0.11.

Recruits enter the population at the beginning of the first year after they are spawned. Recruit numbers are calculated from the number of eggs spawned and associated survival to their first year. The number of eggs produced for each mature female (over 125 cm in length) was calculated from the fecundity-body weight equation, eggs= -1172+625weight.

Sturgeon abundance by age class was determined by proportioning the population estimate on the basis of the percentage of each age class represented in the total sample.

Exploitation rates used in the model are constant by age, sex and period. The model allows for the user to specify open season for angler harvest and vulnerable size limits. The length at which a sturgeon first becomes vulnerable to the fishery can be specified as well as any known hooking mortality. The model also provides for the application of four variations in length limits as follows:

(1) No limit;
(2) Slot limit--minimum-maximum length, fish outside range;
(3) Minimum length limit;
(4) Window limit--minimum-maximum length, fish inside range.

Numbers of sturgeon in the spawning population (over 4 feet) over a 27 year simulation period were estimated using different mortality and exploitation rates. The criteria for determining whether or not harvest could be allowed was the maintenance of spawner numbers at or above the 1984 level. Exploitation was limited to those sturgeon that had reached maturity (over 125 cm) and were less than 183 cm. I considered sturgeon over 183 cm in length to be trophy fish and exempt from harvest.

Data used for input into the simulation model is described by Cochnauer (1983) and is summarized in Table 1.

Table 1. Summary of data used in simulation modeling of white sturgeon population in Snake River between C.J. Strike and Bliss dams, Idaho.

	Age Class														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Numbers	1302	956	698	504	400	300	260	220	158	100	47	32	42	21	16
Total Length (cm)	19	35	49	64	69	74	78	90	97	104	113	127	141	145	161
Mortality rate[a]	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Exploitation rate[b]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	Age Class														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Numbers	16	20	5	0	16	5	10	0	10	5	0	5	0	0	5
Total Length (cm)	162	164	170	184	198	201	204	207	210	213	216	219	222	225	251
Mortality rate[a]	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Exploitation rate[b]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a]Mortality rates of 0.17 and 0.11 were also used for all age classes.

[b]Exploitation rates of 0.05, 0.10, 0.15 and 0.20 were also used for all age classes.

Number of years to simulate 15: Number of periods per year 4: Number of age classes 30: Julian date which begins each period 1, 60, 152, 244: Julian date season starts 1:
Julian date season ends 365: Period in which spawning occurs 2: Length at maturity 125 cm: Proportion of average growth attained each period 1. 0%, 2. 20%, 3. 60%, 4. 20%: Eggs per female equation Eggs = -1172 + 625 Weight: Hooking mortality 0%: Type of fishery Window limit, minimum size 125 cm and maximum size 183 cm:
Minimum size susceptible to fishery 60 cm: Lenght weight equation Weight = 0.0000003 Length$^{3.6127}$

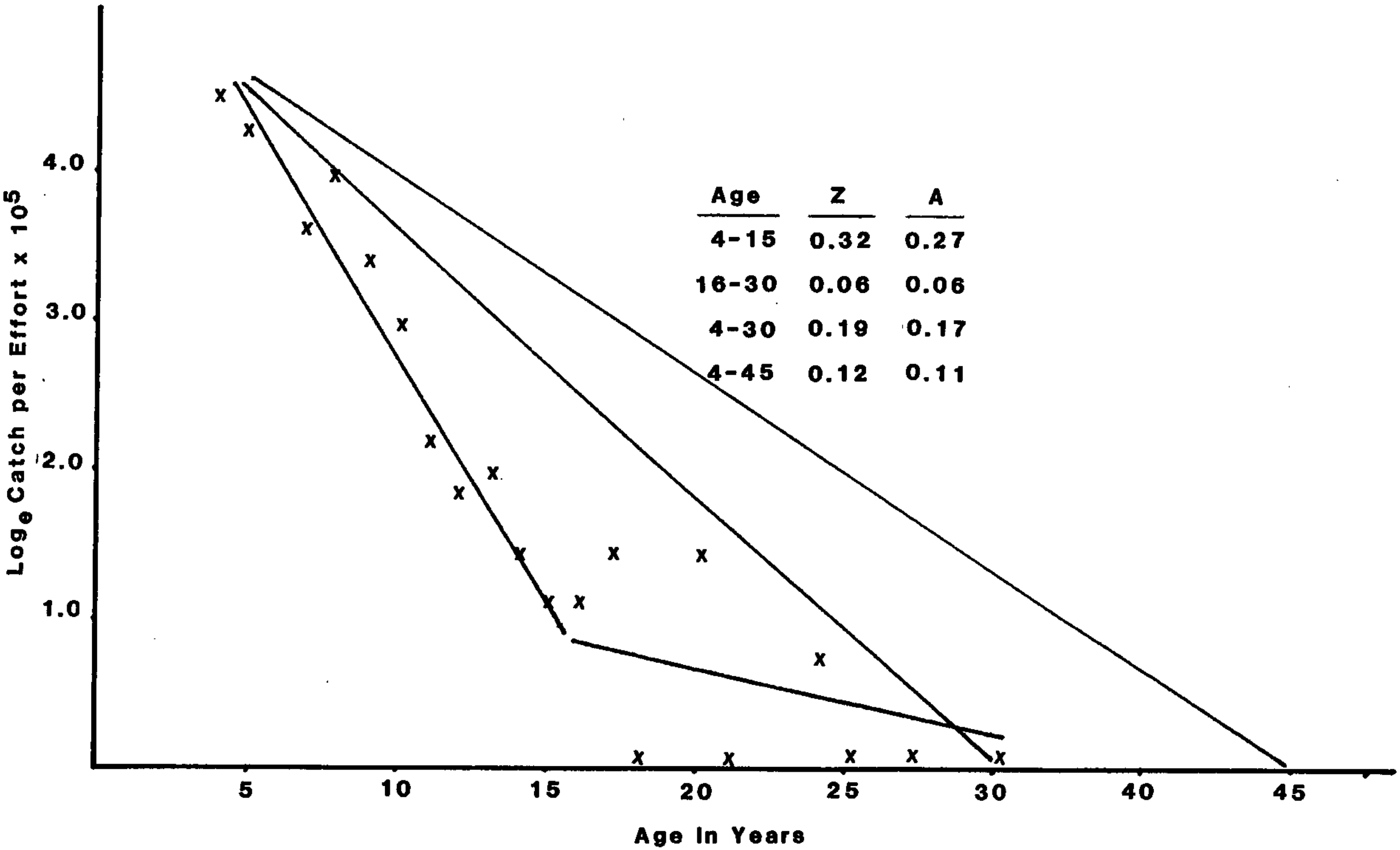

Figure 2. Comparison of the slopes of catch curves of different age classes using rod and reel catch (per 10,000 hours) of white sturgeon from the Snake River (C.J. Strike Dam to Bliss Dam), Idaho, 1979-81. Comparison of instantaneous (Z) and annual (A) mortality rates are also made.

FINDINGS

With the highest mortality rate (0.27) and no harvest, the abundance of spawning age sturgeon will gradually increase from about 200 to 300 fish in 27 years of simulation (Fig. 3). With the lower mortality rates of 0.17 and 0.11, abundance of spawners would increase 5 and 31 times, respectively, in the same time period. Exploitation, legal or otherwise, of E=0.10, would cause a gradual decline in abundance if mortality rates were 0.27-0.06, but would only slow the increase in abundance in the other two cases with lower mortality rates (Fig. 4), assuming that the population increase was not limited by some yet undetermined factor.

The rate of harvest that will maintain spawner numbers at the 1984 level between Bliss and C.J. Strike dams cannot be accurately defined without better knowledge of mortality rates and numbers of eggs successfully hatched. If natural mortality rates were 0.27 (ages 4-15) and 0.06 (ages 16-30), six sturgeon between 125 and 183 cm could be harvested annually and still maintain spawners at the 1984 level (Fig. 4). Because the 0.27 rate is likely an overestimate, an annual allowable harvest of six sturgeon is probably conservative.

A critical assumption used in the population simulation was that mortality and growth were not density dependent. The only documented example of density dependent mortality or growth for sturgeon was reported by Khoroshko and Vlasenko (1970). They found that relatively high numbers of dead eggs on spawning grounds of sevryuga sturgeon (<u>Acipenser stellatus</u>) in the Kuban River, Russia, could be the result of over-compaction of egg masses and that the optimum density is 3.0 to 3.5 thousand eggs per meter square.

Assuming the number of eggs that could successfully hatch is the number available in 1980, populations with mortality rates of 0.27, 0.17 and 0.11 were simulated (Fig. 5). Spawner numbers with the highest mortality rate of 0.27 would remain at or near 1984 levels for the entire simulation period. A population with natural mortality of 0.17 would increase approximately threefold until a constant maximum number was reached while sturgeon with natural mortality of 0.11 would increase in numbers over 7.5 times.

If the number of juveniles entering the population were at a constant level, then the mortality rate of 0.27 (ages 4-15) would be an accurate estimate. However, the mortality rate of 0.06 for ages 16-30 could still be an inaccurate estimate because of the unknown harvest prior to 1970. In this population, no harvest could be allowed if the criteria of maintaining the 1984 level of spawners is to be met.

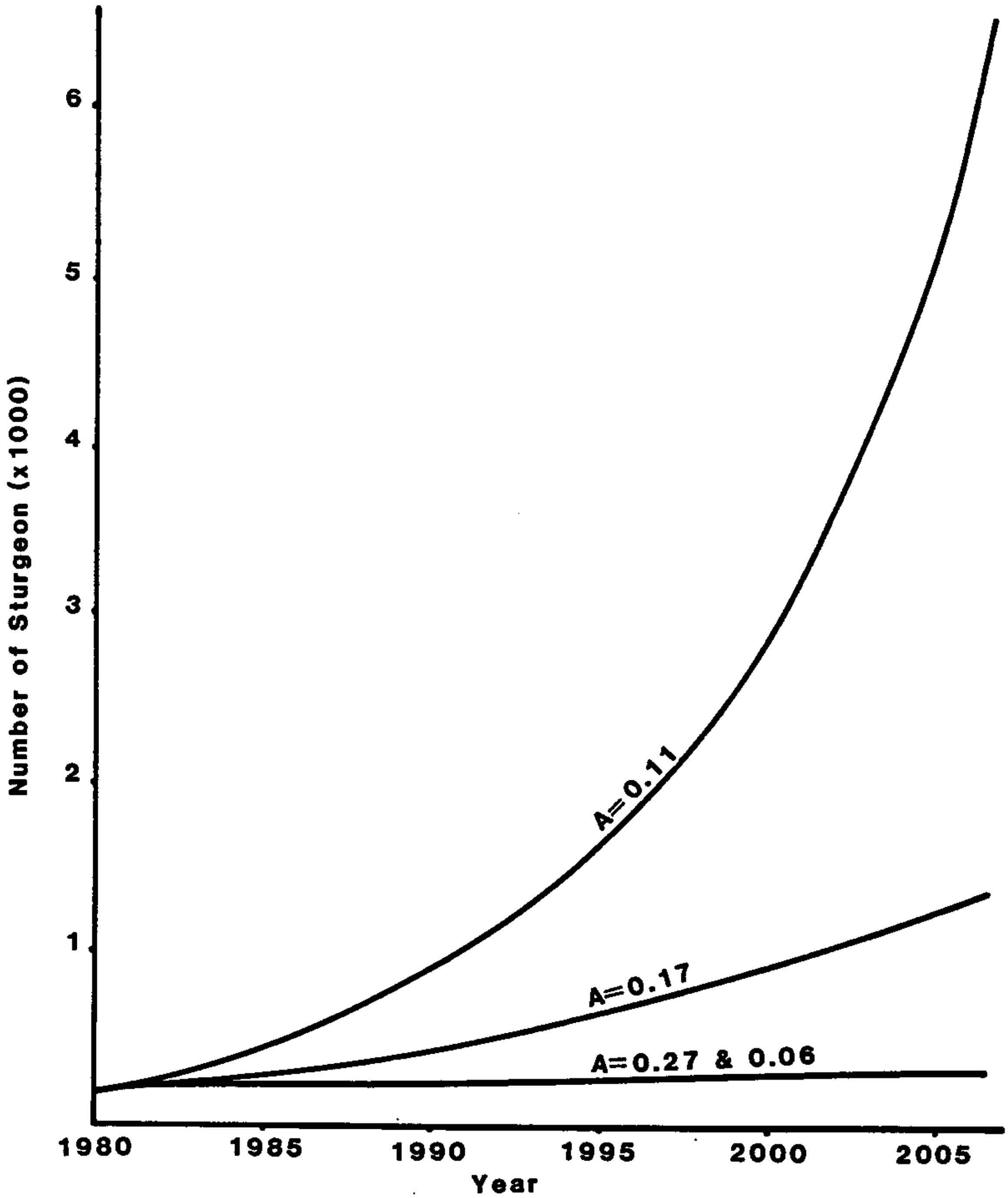

Figure 3. Response of spawning population (over 125 cm) of Snake River white sturgeon (C.J. Strike Dam to Bliss Dam) for three different mortality rates (A) based on simulation of the population over a 27-year period.

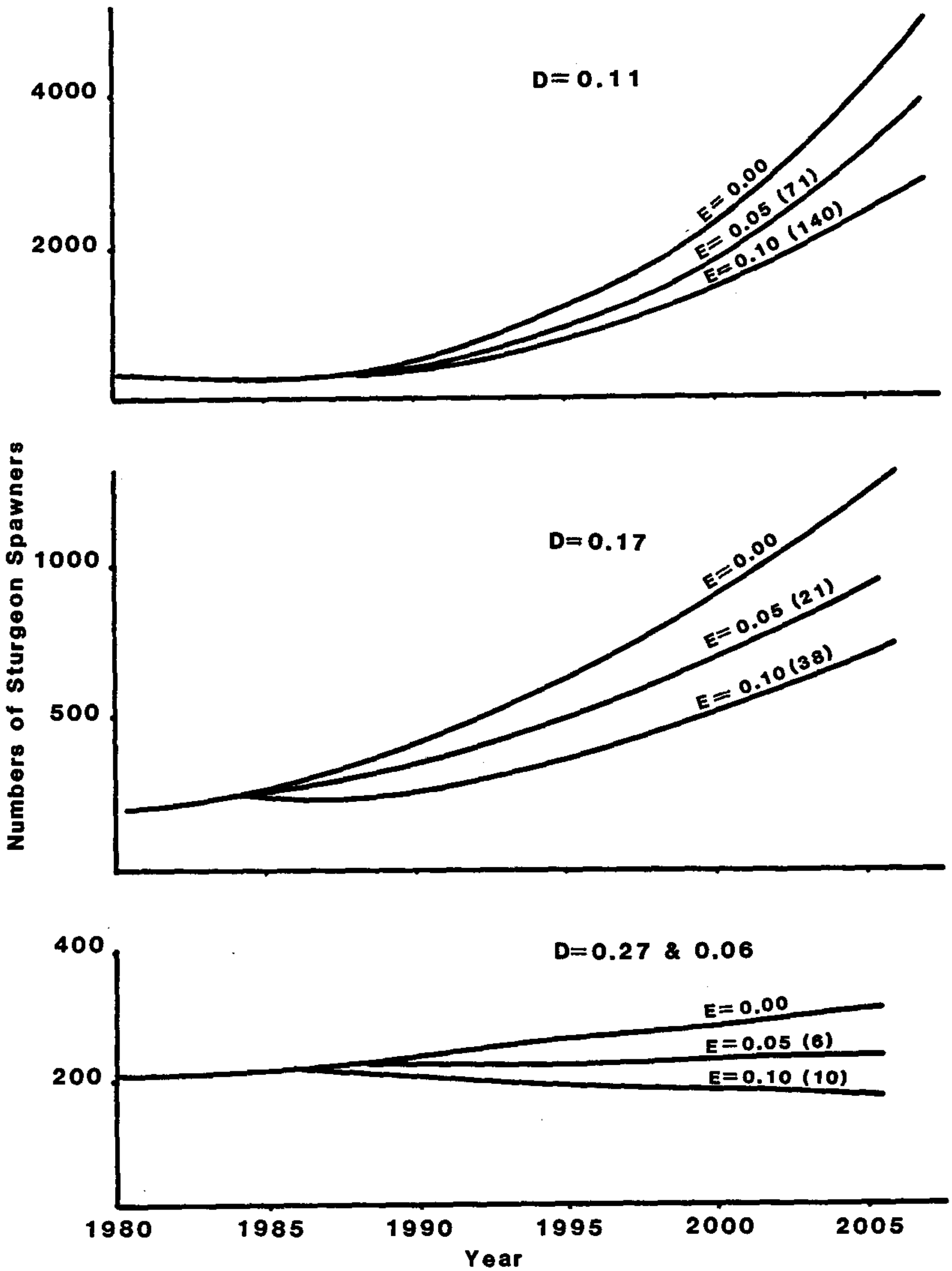

Figure 4. Response of white sturgeon spawning populations in Snake River (C.J. Strike Dam to Bliss Dam) with different mortality (D) and exploitation (E) rates. Numbers in parenthesis () are average numbers of sturgeon (125 to 183 cm) harvested annually.

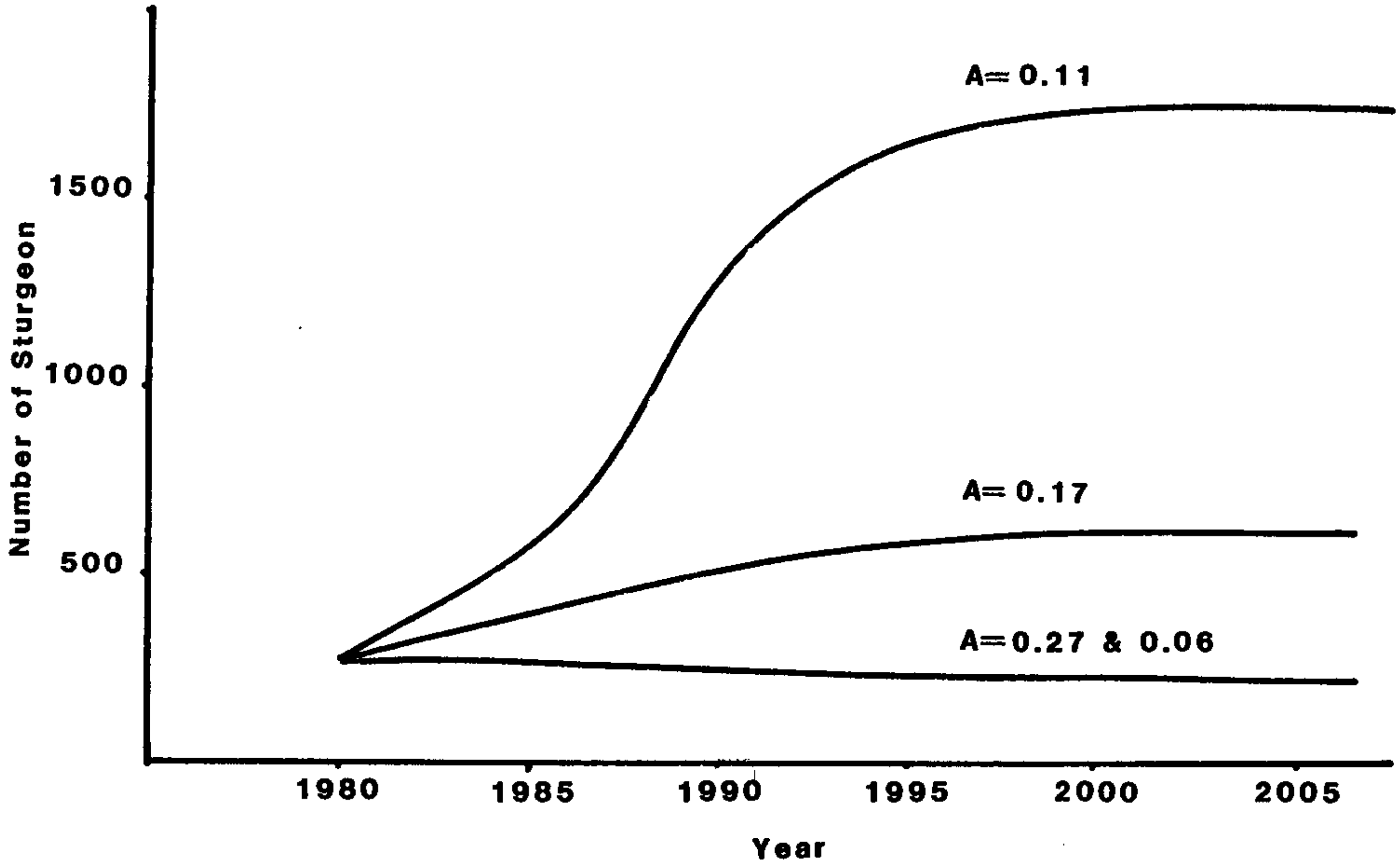

Figure 5. Response of white sturgeon spawning population (over 125 cm) in Snake River (C.J. Strike Dam to Bliss Dam) to different mortality rates (A). The number of juvenile recruits into age class 1 was assumed to be a constant and limited to the estimated numbers in that age class in 1980.

DISCUSSION

Harvest of sturgeon could vary from zero upward depending on mortality and exploitation rates and whether the numbers of juvenile recruits vary or are constant. I do not believe that the number of juvenile recruits is constant at the 1980 level. The numbers of sturgeon are probably still increasing, but I would expect them to reach a maximum level because of the limited potential spawning habitat below Bliss Dam. Although no exact harvest estimate can be determined, some harvest of 125 to 183 cm sturgeon could be allowed and still maintain spawner levels at or above the 1984 number. Assuming the most conservative situation where annual mortality is 0.27 for younger fish, an estimated six sturgeon could be harvested annually.

LITERATURE CITED

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JOB PERFORMANCE REPORT

State of:	Idaho	Name:	River and Stream Investigations
Project No.:	F-73-R-6	Title:	Fish Inventory System
Study No.:	I		
Job No.:	3		

Period Covered: 1 March 1983 to 29 February 1984

ABSTRACT

Work by the departments of Fish and Game and Water Resources personnel continued on the development of the fish inventory system. A physical habitat descriptive section is being incorporated into the creel census and fish population portions of the system. Regional fishery file and summarized annual report data are being coded for entry into the system.

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OBJECTIVE

To implement a computerized system for storage and retrieval of fishery data.

INTRODUCTION

The Idaho Department of Fish and Game is in the process of developing a computer based storage and retrieval system for state-wide fishery data. During 1981 through 1983, the Department has cooperated with Boise State University and Idaho Department of Water Resources to develop this system.

STATUS

Idaho Department of Water Resources personnel are continuing to upgrade the program that stores fish population and creel census data and prepare report formats for those data bases. They are also working on integrating a physical habitat data system for inclusion into the total system. Department of Fish and Game personnel visited each regional office in 1983 and coded all fishery file data for entry into the system. This information is presently being entered on tapes for transfer to the main computer system in Boise. We have also started coding summarized data presented in Department annual reports.

JOB PERFORMANCE REPORT

State of:	Idaho	Name:	River and Stream Investigations
Project No.:	F-73-R-6	Title:	River and Stream Research Supervision and Planning
Study No.:	I		
Job No.:	4		

Period Covered: 1 March 1983 to 29 February 1984

ABSTRACT

Supervision was provided for two research projects during 1983, and personnel involved in those projects were evaluated. Annual budgets and a five-year fishery research program were developed in coordination with regional and headquarters staff personnel

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OBJECTIVE

To provide administrative support to field biologists on river projects.

TECHNIQUES USED

This project involved supervision of river and stream research studies and evaluation of those personnel involved. Coordination with regional and Boise staff personnel was necessary to plan future projects and supervise existing ones.

FINDINGS

I provided administrative support to two river and stream projects (Hells Canyon Sturgeon Studies and BLM Stream Flow Studies) during 1983. I evaluated three Department personnel (Vern Ellis, Bill Horton and Jim Lukens) who were under my supervision during this year. I met with these individuals on a regular basis to discuss progress of their projects and assisted with their projects whenever necessary. I reviewed and edited four annual reports (Hells Canyon Sturgeon Studies, BLM Stream Flow Studies, Hayden Lake Fishery Investigations and Clearwater River Steelhead Investigations).

I coordinated with regional and Boise staff personnel in developing the 5-year (1983-88) research program for river and stream research I also worked on the 1984-85 research budget.

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